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RESEARCH ARTICLE

Three new species of *Crenitis* Bedel, 1881 from South Africa, with a revised key to African species (Coleoptera: Hydrophilidae)

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Abstract

Three new species of *Crenitis* Bedel, 1881 are described from South Africa; *C. castellus* sp.n. and *C. rupestris* sp. n. from the KwaZulu-Natal Drakensberg, and *C. quagga* sp.n. from the Western Cape Province. All three new species were found in madicolous habitats, which appear to be characteristic for a number of species of the genus. A revised key to African species of *Crenitis* is included.

Keywords: Coleoptera; Hydrophilidae; new species; madicolous habitats; South Africa

Introduction

Crenitis Bedel, 1881 currently includes 42 species (Hansen 1999; Hebauer 1994, 2005; Bilton 2013), spread across the Palaearctic, Nearctic and Afrotropical Regions. Much of the diversity of *Crenitis* is concentrated in temperate regions, all of the nine African species described to date being restricted to the Republic of South Africa (Hebauer 1994; Bilton 2013). In terms of ecology, many species are associated with springs or seepages (Hebauer 1994) and the genus appears to be related to the New Zealand endemic *Horelophus* Orchymont, 1913 and the new world *Crenitulus* Winters, 1926 (Short and Fikáček 2013; Fikáček and Vondráček 2014), some of which occur in similar habitats (Fikáček et al. 2012). Recent fieldwork in South Africa has revealed the presence of three new species, which are described below, together with a revised key to Afrotropical species. All new taxa were found in madicolous habitats in mountainous areas and it appears highly likely that further work will reveal additional, undescribed, species in the region.

Materials and methods

Beetles were collected by hand from wet rock seepage habitats, killed with ethyl acetate vapour and preserved in ethanol (70–96%).

Specimens were studied using Leica MZ8 and M205C stereomicroscopes, with a Fluopac FP1 fluorescent illuminator. Digital photographs were taken with a Canon EOS 500D camera fitted to a Leica Z6 Apo macroscope, equipped with a 2x objective lens. Specimens were illuminated using two Fluopac FP1 illuminators. Genitalia were mounted on glass slides in Kisser's glycerol gelatine (see Riedel 2005) and imaged using an Olympus CX31 microscope fitted with the same Canon camera. Image stacks were produced by hand, and combined using Zerene Stacker software (www.zereneystems.com).

Exact label data for specimens are cited in quotation marks. A slash (/) indicates separate label lines.

Abbreviations

CDTB	Collection D.T. Bilton, Plymouth, UK
ISAM	Iziko South African Museum, Cape Town, South Africa
NMPC	National Museum (Natural History), Prague, Czech Republic
NMW	Naturhistorisches Museum Wien, Vienna, Austria
OUMNH	Oxford University Museum of Natural History, Oxford, UK
SANC	South African National Collection of Insects, Pretoria, South Africa
TMSA	Ditsong (Formerly Transvaal) Museum of Natural History, Pretoria, South Africa
DMHF	Dimethyl Hydatoin Formaldehyde, aqueous solution
EL	Elytral length
MW	Maximum width, elytra
TL	Total length, front of head to elytral apex

Taxonomy

***Crenitis castellus* sp. n.**

Type locality

South Africa, KwaZulu-Natal, UKhuhlamba Drakensberg National Park, wet rock seepages below Giant's Castle, 29°15'24.24"S, 29°31'49.92"E, 1,757 m (Figure 3a–b).

Type material

Holotype. ♂ '26/xii/2016 South Africa KZN/ Drakensberg NP – wet rock/ seepages below Giant's/ Castle D T Bilton leg.' (ISAM). Genitalia dissected and mounted on same card. With red holotype label.

Diagnosis

This species is morphologically close to *C. rupestris* sp. n., sharing a similar habitus, pattern of femoral pubescence, dorsal punctation and basic structure of the aedeagus. It differs from *C. rupestris* sp. n. in the smaller body size (1.95 mm vs. 2.0–2.45 mm – although caution is required as *C. castellus* sp. n. is only known from the holotype), the shorter fields of pubescence on the pro- and mesofemora, the less elongate, more swollen apical segment of the maxillary palpi, and the slightly finer and sparser punctation of the head and pronotum. The hooked paramere apices (Figure 2a) are diagnostic.

Description

Size and shape. Holotype TL = 1.95 mm; EL = 1.35 mm; MW = 1.15 mm. Habitus broadly oval (Figure 1a).

Colouration. Dorsum (Figure 1a) with head entirely black, pronotum black with broad, straw yellow lateral margins, yellow colouration extending over lateral thirds of anterior and posterior margins. Elytra dark brownish black, paler in apical third and with narrow straw yellow margins from shoulders to apex. Legs straw yellow, tarsi and femora somewhat infuscated. Antennae yellow brown, club darker. Maxillary palpi with segments 1–3 brown, 4 darker, especially in distal half. Ventral face pitchy brown to black; pronotal lateral hypopleuron and elytral epipleura and pseudepipleura straw yellow.

Head. Compound eyes relatively larger, weakly protruding; distance between eyes approximately 5 x eye diameter when viewed directly from above. Labrum with moderately sized, moderately spaced punctures, spaced approximately 1–2 puncture widths apart. Cuticle shining between punctures, no microreticulation. Clypeus and frons with moderately sized, moderate to sparse punctures, slightly larger than those on labrum. Punctures spaced approximately 1 puncture width apart on clypeus; 4–5 puncture widths apart on posterior frons. Clypeus and frons shining, weakly shagreened. Frontoclypeal suture weak, arcuate. Temples and vertex with weakly transverse, fine microreticulation. Antennae 9 segmented. Maxillary palpi moderately long, stout, segment 2 approximately 1.5 x length of 3. Segments 2 and 3 swollen apically, segment 4 swollen, with almost straight inner margin, and strongly arcuate outer margin, apex truncate.

Pronotum. Broadly transverse, 2.5 x wider than long. Strongly convex, without depressions. Anterior margin broadly arcuate; posterior margin weakly bisinuate around centre; lateral margination narrow and even. Anterior and posterior angles broadly rounded. Surface shining, without microreticulation, with moderately sized sparse punctures spaced approximately 5–7 puncture widths apart, somewhat denser close to margins.

Elytra. Slightly elongate, with lateral margins weakly rounded, subparallel anteriorly then rounded to apex. Sutural stria well impressed. Elytra with moderately sized and relatively dense punctures, seriate anteromedially.

Ventral face. Mentum smooth and shining, without microreticulation in posterior half. Anterior half with some transverse wrinkles and medium punctures laterally. Prosternum and mesoventrite without any traces of medial gibbosities. Hydrofuge hairs relatively sparse on head, prosternum, mesoventrite and metaventrite; dense on all abdominal ventrites. Metaventrite with raised, convex middle portion, with vestiture reduced posteriorly. Elytral epipleura broad in basal half, narrowing abruptly between meso- and metacoxae (Figure 2a).

Legs. Relatively short, tarsi shorter than tibiae on all limbs, especially forelegs. Meso- and metatarsi with segments 2 and 5 more elongate than others. Profemur pubescent, with long setae over mesal two fifths. Mesofemur pubescent over mesal two thirds, metafemur pubescent at extreme base and along mesal two thirds of anterior and posterior margins, otherwise glabrous, shining (Figure 2a).

Aedeagus. Phallobase approximately 2 x length of parameres, manubrium approximately half the length of wider basal part. Parameres short, narrowing abruptly to outwardly hooked apices. Median lobe with bluntly rounded apex, which reaches paramere apices. Struts slightly shorter than lobe; extending approximately half the length of the wider part of the phallobase (Figure 2d).

Female. Unknown.

Etymology. From the Latin *castellus*, *castellum* (= small camp, fort), in reference to the type locality. The name is a noun in apposition.

Habitat and distribution. To date only known from the type locality (Figure 3a–b), a wet rock face in the eastern Drakensberg, where it occurred together with numerous *C. rupestris* sp. n.

Figure 1 around here

***Crenitis rupestris* sp. n.**

Type locality

South Africa, KwaZulu-Natal, UKhuhlamba Drakensberg National Park, wet rock seepages below Giant's Castle, 29°15'24.24"S, 29°31'49.92"E, 1,757 m (Figure 3a-b).

Type material

Holotype. ♂ '26/xii/2016 South Africa KZN/ Drakensberg NP – wet rock/ seepages below Giant's/ Castle D T Bilton leg.' (ISAM). Genitalia dissected and mounted on same card. With red holotype label. *Paratypes*. 8♂, 10♀, same data as holotype (CBP, NMPC, NMW, ISAM, OUMNH, SANC, TMSA). 4♂, 1♀ '27/xii/2013 South Africa KZN/ UKhahlamba Drakensberg NP/ 2nd stream below Van Heyningen's/ Pass @ Injisuthi D T Bilton leg.' (CBP). 14♂, 4♀ 'R. SOUTH AFRICA: E Cape/ Amathole district. Nxuba l. m./ Fort Fordyce Nature Reserve/ 32.6803°S 26.4899°E; 4-6.i.2015/ P. Šipek and P. Malec lgt./ seepage/hygropetric habitat' (NMPC). 1♀ 'R. SOUTH AFRICA: KwaZuluNatal/ Ugu district; Hibiscus Coast L.m./ Oribi Geore [?Gorge]; 30.6795°S 30.2642°E/ 8-9.i.2015/ P. Šipek and P. Malec lgt./ hygropetric habitat:/ Samanga falls/ CRENITIS' [CRENITIS HW] 'MF1345' (NMPC). All with red paratype labels.

Diagnosis

See under *C. castellus* sp. n. above.

Description

Size and shape. Holotype TL = 2.45 mm, EL = 1.65 mm, MW = 1.30 mm; paratype males TL = 2.0–2.45 mm, EL = 1.30–1.65 mm, MW = 0.95–1.35 mm; paratype females TL = 2.20–2.85 mm, EL = 1.50–1.95 mm, MW = 1.05–1.40 mm. Habitus broadly oval (Figure 1b).

Colouration. Dorsum (Figure 1b) with head entirely black, pronotum black with broad, straw yellow lateral margins, yellow colouration extending over lateral thirds of anterior and posterior margins. Slight aeneous green reflection on head and dark parts of pronotum. Elytra dark brownish black, paler in apical third and with narrow straw yellow margins from shoulders to apex. Legs straw yellow, tarsi and femora somewhat infuscated. Antennae yellow brown, club darker. Maxillary palpi with segments 1–3 brown, 4 darker, especially in distal half. Ventral face pitchy brown to black; pronotal lateral hypopleuron and elytral epipleura and pseudepipleura straw yellow.

Head. Compound eyes relatively large, weakly protruding; distance between eyes approximately 5 x eye diameter when viewed directly from above. Labrum with moderately sized, moderately spaced punctures, spaced approximately 1–2 puncture widths apart. Cuticle shining between punctures, no microreticulation. Clypeus and frons with moderately sized, moderate to sparse punctures, slightly larger than those on labrum. Punctures spaced approximately 1 puncture width apart on clypeus; 4–5 puncture widths apart on posterior frons. Clypeus and frons shining,

weakly shagreened. Frontoclypeal suture weak, arcuate. Temples and vertex with weakly transverse, fine microreticulation. Antennae 9 segmented. Maxillary palpi moderately long, stout, segment 2 approximately 1.7 x length of 3. Segments 2 and 3 slightly swollen apically, segment 4 swollen, with almost straight inner margin, and strongly arcuate outer margin, apex truncate.

Pronotum. Broadly transverse, 2.5 x wider than long. Strongly convex, without depressions. Anterior margin broadly arcuate; posterior margin weakly bisinuate around centre; lateral margination narrow and even. Anterior and posterior angles broadly rounded. Surface shining, without microreticulation, with moderately sized sparse punctures spaced approximately 5–7 puncture widths apart, somewhat denser close to margins.

Elytra. Slightly elongate, with lateral margins weakly rounded, subparallel anteriorly then rounded to apex. Sutural stria well impressed. Elytra with moderately to coarsely sized, relatively dense punctures, seriate anteromedially.

Ventral face. Mentum smooth and shining, without microreticulation in posterior half. Anterior half with some transverse wrinkles and medium punctures laterally. Prosternum and mesoventrite without any traces of medial gibbosities. Hydrofuge hairs relatively sparse on head, prosternum, mesoventrite and metaventrite; dense on all abdominal ventrites. Metaventrite with raised, convex middle portion, with vestiture reduced posteriorly. Elytral epipleura broad in basal half, narrowing abruptly between meso- and metacoxae (Figure 2b).

Legs. Relatively short, tarsi shorter than tibiae on all limbs, especially forelegs. Meso- and metatarsi with segments 2 and 5 more elongate than others. Profemur pubescent, with long setae over mesal two thirds. Mesofemur pubescent over mesal three quarters, metafemur pubescent at extreme base and along mesal two thirds of anterior and posterior margins, otherwise glabrous, shining (Figure 2b).

Aedeagus. Phallobase approximately 2 x length of parameres, manubrium approximately half length of wider basal part. Parameres short, narrowing abruptly to pointed apices, outer margins slightly concave; resembling watchmaker's forceps. Median lobe with bluntly rounded apex, which reaches paramere apices. Struts approximately half length of median lobe; extending approximately half the length of the wider part of the phallobase (Figure 2e).

Female. Maxillary palpi not expanded, otherwise externally identical to males.

Variation. Other than variation in size (see above) some specimens differ in the degree of development of paler markings on apex and lateral margins of the elytra, some appearing lighter than the holotype. There is some variation in the aedeagus, which can be observed within a single locality: In some specimens, the narrow portion of the basal piece is narrower than illustrated in Figure 2e. In other cases the

outer margins of the parameres are somewhat less concave than shown in Figure 2e.

Etymology

From the Latin *rupes* (= cliff), in reference to the habitat on wet, near vertical rock faces. The name is an adjective in the nominative singular.

Habitat and distribution. Known from the eastern Drakensberg (Figure 3a), further west along the Great Escarpment at Fort Fordyce Nature Reserve and at Oribi Gorge, southest of the Drakensberg in KwaZulu-Natal. On this basis, the species seems likely to be widespread in suitable habitats in the region. All specimens collected from madicolous habitats (e.g., Figure 3b).

Figure 2 around here

***Crenitis quagga* sp. n.**

Type locality

South Africa, Western Cape, Piketberg Mountains, wet rock seepages in valley below Sebrakop, 32° 46' 18.08"S 18° 45' 55.42"E, 923 m (Figure 3c).

Type material

Holotype. ♂ '3/x/2015 South Africa WC/ Piketberg – rock seeps/ @ 920 m below/ Sebrakop D T Bilton leg.' (ISAM). Genitalia dissected and mounted on same card. With red holotype label. *Paratype.* 1♂, same data as holotype (CBP). With red paratype label.

Diagnosis

Crenitis quagga sp. n. resembles *C. lineata* Hebauer, 2005 in having a pattern of longitudinal stripes, but in known specimens of the new species, these are only distinct apicolaterally. The two species differ significantly in the form of the aedeagus; *C. quagga* sp. n. having straight inner margins to the parameres (Figure 2c), which are strongly concave in *C. lineata* (Figure 3 in Hebauer 2005). In addition, in *C. quagga* sp. n. the manubrium is very strongly demarcated from the remainder of the phallobase, whereas these two regions are much more continuous in *C. lineata*.

Description

Size and shape. Holotype TL 2.85 mm, EL 1.85 mm, MW 1.35 mm; paratype TL 2.85 mm, EL 1.85 mm, MW 1.35 mm. Habitus elongate oval (Figure 1c).

Colouration. Dorsum (Figure 1c), with head entirely black, pronotum black with lateral margins broadly yellow, anterior margins narrowly yellow, posterior margins yellow in lateral thirds. Elytra chestnut brown with yellowish longitudinal stripes,

these being more evident posteriorly and laterally and absent or reduced to longitudinal spotting on anterior disc. Legs brownish to black, femora and tibiae darker than tarsi; trochanters pale brown. Maxillary palpi pitchy brown to black with apices of segments 2 and 3 somewhat paler. Antennae with basal segments brown, club black. Venter pitchy brown to black, except elytral pseudopipleurs, outer epipleurs and lateral hypopleuron of pronotum brownish yellow.

Head. Compound eyes large and protruding, distance between eyes slightly greater than 4 x eye diameter when viewed directly from above. Labrum with dense, coarse punctures, spaced approximately 0.5–1 puncture widths apart. Clypeus and frons with very coarse, close punctures, spaced 0.3–1 puncture widths apart; punctures smaller and almost confluent along inner margins of compound eyes. Surface shining between punctures, shagreened, this becoming stronger and more evident close to posterior margins of eyes. Temples with fine, slightly transverse microreticulation. Frontoclypeal suture weak but clearly visible. Antennae 9 segmented. Maxillary palpi slightly longer than head; segment 2 swollen apically, segment 3 shorter than 2, also swollen apically, but less so; segment 4 as long as 2, almost straight on inner face, arcuate on outer face, swollen, truncate at apex.

Pronotum. Broadly transverse, approximately 3 x wider than long. Moderately convex, without depressions. Anterior margin broadly arcuate; posterior margin bisinuate around central third. Lateral margins straight in centre, rounded to anterior and posterior margins; lateral margination narrow and even. Anterior and posterior angles broadly rounded. Surface shining, weakly shagreened, without microreticulation, with dense, coarse punctures spaced approximately 0.3–1 puncture widths apart, becoming smaller and denser close to margins.

Elytra. Elongate, broadest behind middle. Subparallel in basal two thirds, then broadly rounded to apex. Sutural stria well impressed. Elytra with close, coarse punctures, spaced more widely than on head (approximately 0.8–1.4 puncture widths apart); weakly seriate. Scattered larger punctures bearing long, fine trichobothria also present, both within and between series.

Ventral face. Mentum strongly emarginated in centre, shining, with weak, transverse microreticulation and sparse, coarse punctures, some which bear long decumbent setae. Prosternum and mesoventrite without traces of medial gibbosities. Hydrofuge pubescence present, particularly on anepisterna, metaventrite and abdominal ventrite. Metaventrite with raised, convex middle portion, with vestiture reduced posteriorly. Elytral epipleurs broad in basal third, then narrowing rapidly adjacent to metacoxae (Figure 2c).

Legs. Relatively long, pro and mesotarsi as long as tibiae; metatarsi approximately two thirds length of tibiae. Mesal portion of pro- meso- and metafemora densely pubescent, with both long and short setae. Profemora pubescent over mesal 0.4; meso- and metafemora over mesal half (Figure 2c).

Aedeagus. Phallobase approximately 2 x length of parameres, manubrium strongly defined and approximately equal in length to wider basal part. Parameres narrowing abruptly in apical 1/3 to bluntly pointed apices. Outer margins slightly concave in apical 1/3. Median lobe with bluntly rounded apex, which reaches paramere apices. Struts slightly shorter than lobe; extending approximately 2/3 length of the wider part of the phallobase (Figure 2f).

Female. Unknown

Variation. Paratype with no significant differences from holotype.

Etymology

Named after the quagga (*Equus quagga quagga* (Boddaert, 1785)), an extinct zebra from South Africa which was also partly striped. The name is a noun in apposition.

Habitat and distribution. To date only known from the type locality (Figure 3c), seepages on a wet rock face close to the summits of the Piketberg range in the Western Cape of South Africa.

Figure 3 around here

Revised key to African *Crenitis* Bedel, 1881

Modified from Hebauer (1994). Aedeagi of species marked with an asterisk (*) are illustrated in Hebauer (1994, 2005).

- 1 Pronotum and elytra uniformly yellow to rufo-testaceous (occasionally piceous in *C. cinnamonea*). Body shape very elongate. Maxillary palpi much longer than antennae2
- Pronotum predominantly dark brown or black, with distinctly paler margins. Body shape less elongate. Maxillary palpi slightly longer than antennae, or of similar length3
- 2 Head and last joint of maxillary palpi black, parameres with broad, blunt apices ***bicolor* Bilton, 2013**
- Head and last joint of maxillary palpi same colour as remainder of dorsum, parameres with pointed internal apices ***cinnamonea* Hebauer, 1994***
- 3 Dense pubescence on hind femora extensive, occupying half to three quarters of the femoral length4
- Pubescence of hind femora restricted to extreme base and narrow bands along margins6

- 4 Elytra unicolorous brown to black; paler longitudinal stripes occasionally visible when elytron is lifted, but not significantly evident when closed ***zimmermanni* Knisch, 1924**
- Elytra with distinct pale longitudinal stripes, contrasting strongly with background colour, even when closed5
- 5 Pale longitudinal stripes present across elytra, from shoulders to apices; parameres relatively pointed and narrow, with distinctly concave inner faces ***lineata* Hebauer, 2005***
- Pale longitudinal elytral stripes only evident apicolaterally (Figure 1c); parameres broader, with strait inner faces (Figure 2f) ***quagga* sp. n**
- 6 Entire dorsum densely and coarsely punctured; punctures spaced up to 1 puncture width apart7
- Pronotum with relatively fine, sparse punctuation, or without recognizable punctures8
- 7 Metatarsi very long and thin, equal in length to tibiae. Last segment of maxillary palpi not truncate. Pronotum and elytra piceous ***capensis* (d'Orchymont, 1942) ***
- Metatarsi shorter, up to two thirds length of tibiae. Last segment of maxillary palpi subcylindrical and truncate at apex. Pronotum and elytra castaneous ***excusa* Hebauer, 1994***
- 8 Pronotum smooth, shining and almost impunctate ***glabricollis* Hebauer, 1994***
- Pronotum with distinct punctuation9
- 9 Tibiae with long stiff setae. Elytral punctures effaced towards apices. Parameres curved, elongate, with truncately rounded apices ***danielssoni* Hebauer, 1994***
- Tibia short, softer setae. Elytral punctures evident to apices. Parameres not as above10
- 10 Paramere apices broadly truncate, with a strong denticle on internal face close to apex. Pronotal punctures very fine, effaced ***calva* Hebauer, 1994***
- Parameres without internal denticle. Pronotal punctures distinct, almost as large and deep as those on head11
- 11 Parameres with concave outer face and pointed apices, resembling watchmaker's forceps (Figure 2e) ***rupestris* sp. n.**
- Parameres with strong recurved tooth at apices (Figure 2d) ***castellus* sp. n.**

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Figure legends

Figure 1. *Crenitis* species, holotype habituses: (a) *C. castellus* sp. n.; (b) *C. rupestris* sp. n.; (c) *C. quagga* sp. n. (scale bar = 1 mm).

Figure 2. *Crenitis* species, venters and aedeagi: (a, d) *C. castellus* sp. n., holotype; (b, e) *C. rupestris* sp. n., paratype and holotype; (c, f) *C. quagga* sp. n., paratype and holotype (scale bars a–c = 1 mm; d–f 0.25 mm).

Figure 3. *Crenitis* habitats: (a) overview of landscape at Giant's Castle, UKhuhlamba Drakensberg National Park, KwaZulu-Natal, type locality of *C. castellus* sp. n. and *C. rupestris* sp. n.; (b) details of habitat occupied by *Crenitis* spp. at Giant's Castle, beetles collected directly from wet rock faces, beside the small trickles; (c) wet rock face in Piketberg range, Western Cape Province, type locality of *C. quagga* sp. n.